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RESEARCH ARTICLE

First finding of a fossilized Cantharidae (Insecta: Coleoptera) from the Middle Miocene deposits in Romania

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Abstract

The extraordinary fossil sites of Vlădiceni (Iaşi, Romania) recently discovered, with lithostratigraphy of Middle Miocene age, have uncovered a rich fauna especially of fishes, molluscs, amphipods and insects. This includes also the first fossil specimen of family Cantharidae from both this geological formation and from Romania: *Malthodes* (*Malthodes*) *vladiceniensis* **sp. nov.**, which is illustrated and described and compared with living and fossil species of the genus.

Keywords

Compression fossil, *Malthodes*, palaeoentomology, soldier beetle.

Introduction

In 2017, the third author spotted an exceptional bed with a peculiar fossil assemblage in an active quarry in the Blănarului Hill (Iași, Romania), in the sediments of the *Cryptomactra* Formation and the Bârnova-Muntele Formation (Ionesi et al. 2005, 2019, 2020). This bed is now called Vlădiceni 1 (Ionesi et al. 2020). Furthermore, there is another promising site in the same fossiliferous association called Vlădiceni

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2, about 600 meters away from Vlădiceni 1 site (Ionesi et al. 2020). Among many fossils found in both places, a good number is represented by insects, from which a few of them were identified as Coleoptera (such as Curculionidae and Staphylinidae) (Ionesi et al. 2020). The careful examination of the fossilized insects allowed the identification of one member of family Cantharidae (commonly known as soldier beetles), belonging to the genus *Malthodes* Kiesenwetter, 1852, which is studied and described here. Currently, genus *Malthodes* is widespread in the Holarctic and Oriental regions (Delkeskamp 1977; Brancucci 1980; Ramsdale 2002) and includes hundreds of species; this genus being well represented also in Romania. Yet, the knowledge on the Cantharidae family from Romania is poor (Macovei 2012, 2013). About twenty-five living species of *Malthodes* have been reported from here (Kazantsev and Brancucci 2007; Macovei 2012), but the real number is probably much higher and includes several endemic taxa.

Materials and methods

The specimen described here was collected by the third author and his team during the research campaigns carried out in 2019–2020, and it is now preserved at the Museum of Paleontological Collections which is housed inside the Faculty of Geography and Geology, Iași, Romania. The description of the new species was made by comparing both part and counterpart. The holotype has been photographed using a Canon EOS 6D camera equipped with a Canon MP-E 65 mm f/2.8. Eighteen photos were taken for part and counterpart and then combined (stacked) with Zerene Stacker software, 1.04 and then edited in Adobe Photoshop CS6. The illustration was hand-drafted and processed using PhotoImpact Viewer SE software.

Taxonomy

Family Cantharidae Imhoff, 1856
Subfamily Malthininae Kiesenwetter, 1852
Tribe Malthodini Böving and Craighead, 1931
Genus *Malthodes* Kiesenwetter, 1852
Subgenus *Malthodes* Kiesenwetter, 1852

***Malthodes (Malthodes) vladiceniensis* sp. nov.** (Figs 1–2)

Holotype. Male, compression fossil in laminate varve-like fine mudstone from the sediments between the *Cryptomactra* Formation and the Bârnova-Muntele Formation. CODE No. 8231A, 8231B (Part A, Counterpart B).

Type locality. Romania: Iaşi county, Blănarului Hill, Vlădiceni, Vlădiceni 1 site (47.134780°N/27.656524°E).

Type horizon. Middle Miocene (around 11.5 mya). At the base of Bârnova-Muntele Formation.

Etymology. Derived from the toponym Vlădiceni (type locality) + the Latin suffix *-ēnsis*.

Systematic placement. The rounded head behind eyes, the antennae filiform, the short elytra, the small size, the last maxillary palp globular and pointed apically, and particularly the last terminalia strongly modified, suggest that this extinct species would belong to genus *Malthodes*. The last modified abdominal segments also inform us that it is a male. In this genus, indeed, only males can be identified to species level because of the strongly modified last abdominal segments which bear excellent diagnostic characters; female specimens cannot be identified unless associated with males.

The specimen belongs to the nominotypical subgenus *Malthodes*. The fossil subgenus *Libertimalthodes* Kupryjanowicz and Fanti, 2019, has long elytra and the last abdominal segments unmodified, while the living subgenus *Podistrina* Fairmaire, 1875, has an elongated head and pronotum, very short elytrae and has no metathoracic wings (Brancucci 1980, Fanti 2019b).

Differential diagnosis. No fossil taxa of soldier beetles (Cantharidae) from Romania are known until now. Furthermore, no fossil *Malthodes* were known from Miocene and Pliocene. Instead, many *Malthodes* have been described from various Eocene ambers (Fanti 2017, 2019a; Parisi and Fanti 2019, 2020), but only one as a compression fossil is known: *Malthodes obtusus* Förster, 1891 from the Oligocene brown coal deposits of Brunstatt in Alsace, France (Förster 1891). The latter, however, did not preserve the whole last abdominal segments (Förster 1891) and the phylogenetic comparison with the new species described here is not possible. No particular phylogenetic affinities with living species present in Romania have been found, and morphologically *Malthodes* (*Malthodes*) *vladiceniensis* **sp. nov.** is vaguely similar in shape of the last abdominal segments to *Malthodes minimus* (Linnaeus, 1758) but differs by the last tergite, which is here narrower and flatter, and by the last abdominal ventrite, which is shorter, squared and not forked (Liberti 2015). *Malthodes* (*Malthodes*) *vladiceniensis* **sp. nov.** looks primitive and undeveloped, as witnessed by the last tergite and abdominal ventrite which are rather small and simple, and by the last but one abdominal ventrite which does not show any important sclerotization and looks similar to the preceding ones (this abdominal ventrite, in *Malthodes*, usually is clearly or strongly emarginated at its posterior border). *Malthodes* (*Malthodes*) *vladiceniensis* **sp. nov.** is also vaguely similar to *M. holdhausi* Kaszab, 1955 and *M. dieneri* Kaszab, 1955 but it differs by the form of the last abdominal ventrite, which is much shorter, and also by a different shape of the last tergite (Kaszab 1955a, 1955b).

Description. Adult, winged. Male. This species differs from all the other known *Malthodes* by the last abdominal segments: last but one and last tergite (tg9 and tg10) and abdominal ventrites (v8 and v9). Body length: 6.9 mm (we assume that in life it was about 5.8–6.0 mm).

Head small, short, completely exposed, rounded, slightly narrower than pronotum. Eyes large, rounded, convex, interocular dorsal distance probably about 2.3–2.4 times greater than eye diameter. Mandibles not visible. Maxillary palps 4-segmented, unequal in length, with the terminal palpomere globular and distally

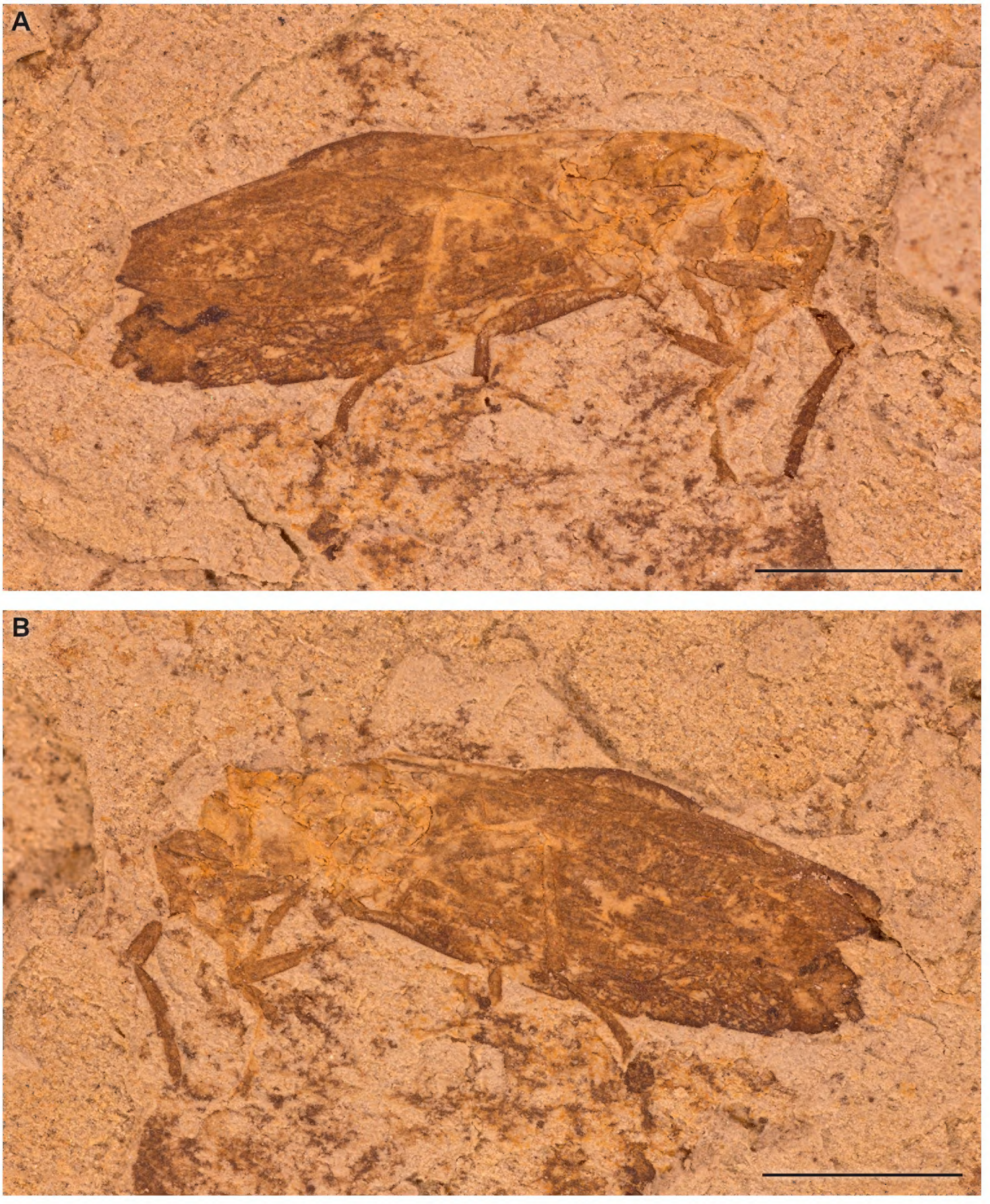

Figure 1. *Malthodes* (*Malthodes*) *vladiceniensis* **sp. nov.** compression from Vlădiceni (Romania). **A** Holotype (Code 8231A, Part A), ventro-lateral view, scale bar = 2.0 mm; **B** Holotype (Code 8231B, Counterpart B), ventro-lateral view, scale bar = 2.0 mm.

pointed. Antennae filiform, relatively short, not completely preserved, antennomere I (scape) relatively short, very robust, club-shaped; antennomere II elongated, robust, approximately 1.2 times longer than scape, antennomere III approximately 1.7 times shorter than second; antennomeres IV–IX short. Pronotum transverse, surface flat, anterior margin slightly bordered, sides slightly undulating, propleura roundish. Elytra short reaching half of abdomen. Metathoracic wings longer than elytra and as long as the last abdominal segments. Legs short and robust; coxae roundish; trochanters elongated, femora enlarged, slightly curved, tibiae cylindrical, slightly longer than femora. Tarsi 5-segmented; tarsomere I elongated; tarsomere II slightly shorter than first; tarsomere III slightly elongated; tarsomere IV bilobed; tarsomere V slender and long; claws not clearly visible but presumably simple. Abdominal ventrites transverse. Penultimate tergite (tg9) robust, subquadrate; last tergite (tg10) narrower than previous one, short and subquadrate, slightly folded at sides; penultimate abdominal ventrite (v8) simple, not emarginated on rear border (apparently it is not much different from the previous ones), last abdominal ventrite (v9) short, slightly elongated, truncated apically. Female unknown.

Remarks. The specimen is very compressed and curled up but during the fossilization the abdomen has also extended and this has allowed a good sight of the last abdominal segments, which, in genus *Malthodes* are the ground for species recognition. Part and counterpart are preserved in ventro-lateral view. The holotype has the right antenna preserved up to the antennomere IX and the left antenna partially visible (it is likely that the antennae were 11-segmented, since all extinct and living taxa have this character). There are five legs preserved, one of them only

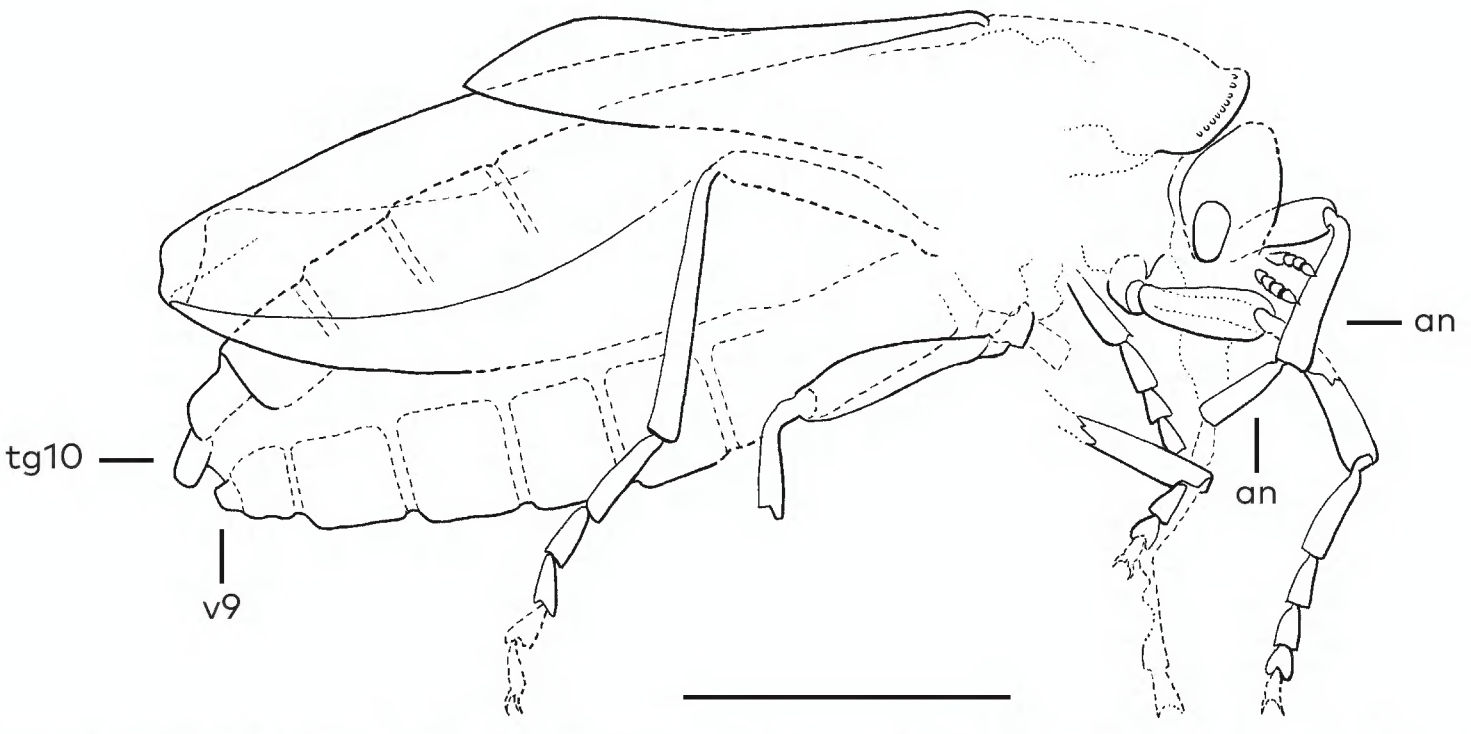

Figure 2. *Malthodes* (*Malthodes*) *vladiceniensis* **sp. nov.** compression from Vlădiceni (Romania). A, Holotype (Code 8231A, Part A), illustration of habitus, scale bar = 2.0 mm; an = antennal segments, tg10 = last tergite; v9 = last abdominal ventrite

partially, up to half of the tibia. The countertype is slightly less visible, and substantially preserved as the holotype.

Discussion

The heterogeneity of the fossils from Vlădiceni sites shows the existence of special conditions when the specimen's sedimentations took place. Because of the occurrence, in the mudstones from Vlădiceni, of many marine organisms (especially molluscs, Foraminifera, ostracods, fish, Mysidae, etc.) it is clear that the sedimentation took place in a marine environment. Based on the type of the mudstones found there (bentonites, which are composed from volcanic ash weathering in seawater; Ionesi et al. 2005), Ionesi et al. (2020) suggest that the cause for mass mortality of the marine and terrestrial organisms all together might have been due to the rapid fall and sedimentation of volcanic ashes. However, further studies are needed to shed more light on this subject. *Malthodes* (*Malthodes*) *vladiceniensis* **sp. nov.** is the first species described from this rich fossiliferous material and represents the first insight into the extinct entomofauna that was present 11.5 million years ago on the Moldavian Platform. This species possibly preyed, as it happens for living species, small arthropods and, in particular, aphids (Goidanich 1954; Fanti and Michalski 2018). Therefore, the presence of the new *Malthodes* species, combined with the great diversity of insects present in this fossil sites (Ionesi et al. 2020), highlights the possibility of existence of open surfaces, interspersed with trees/forests, in that area in Middle Miocene.

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